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Indian Standard

SPECIFICATION FOR COMMERCIAL REFRIGERATORS

(Fifth Reprint AUGUST 1986)

UDC 621.565

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 5

April 1960

Indian Standard

SPECIFICATION FOR COMMERCIAL REFRIGERATORS

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Indian Standard

SPECIFICATION FOR COMMERCIAL REFRIGERATORS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 26 December 1959, after the draft finalized by the Refrigeration and Air Conditioning Sectional Committee had been approved by the Building Division Council.

0.2 Commercial refrigerators are finding increasing application in storage operations. Proper storage facilities are essential in preserving the quality and appearance of food-stuffs. Till recently, refrigeration industry in India had not made much headway, and majority of the parts were being imported and units assembled in India. But during the last few years, the industry has made rapid strides and at the present day most of the components are being made indigenously excepting hermetically sealed and semi-sealed compressors and controls. It is necessary that these indigenous units should conform to certain minimum standards, which is the objective of this standard, so as to ensure satisfactory performance, efficient and sound operation under weather conditions existing in India.

0.3 The Sectional Committee responsible for the preparation of this standard has taken into consideration the present state of air-conditioning and refrigeration industry in the country and the necessity for relating this standard to the existing practices followed in this field in India. Due weigthage has also been given to the need for international co-ordination among standards prevailing in different countries of the world. These considerations led the Sectional Committee to derive assistance from B.S. 2501 : 1954 Specification for Manufacture and Testing of Refrigerating Cabinets Reach-in Type), published by the British Standards Institution.

0.4 This standard is one of a series of Indian Standards on refrigerating and air-conditioning equipment. The series at present comprises the following specifications and codes:

*IS : 655-1955 SPECIFICATION FOR METAL AIR DUCTS

*IS : 659-1955 SAFETY CODE FOR AIR CONDITIONING

*IS : 660-1955 SAFETY CODE FOR MECHANICAL REFRIGERATION

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*Since revised.

*IS : 661-1955 CODE OF PRACTICE FOR INSULATION AND SAFE OPERATION OF COLD STORAGES

*IS : 1475-1959 SPECIFICATION FOR SELF-CONTAINED WATER COOLERS

*IS : 1476-1959 SPECIFICATION FOR DOMESTIC REFRIGERATORS (MECHANICALLY OPERATED)

0.5 This standard requires reference to the following Indian Standards:

*IS : 325-1959 SPECIFICATION FOR THREE-PHASE INDUCTION MOTORS (*Revised*)

*IS : 660-1955 SAFETY CODE FOR MECHANICAL REFRIGERATION

*IS : 661-1955 CODE OF PRACTICE FOR INSULATION AND SAFE OPERATION OF COLD STORAGES

*IS : 732-1958 CODE OF PRACTICE FOR ELECTRICAL WIRING AND FITTINGS IN BUILDINGS

*IS : 996-1959 SPECIFICATION FOR SMALL AC AND UNIVERSAL ELECTRIC MOTORS WITH CLASS ' A ' INSULATION

*IS : 1068-1958 SPECIFICATION FOR COPPER, NICKEL AND CHROMIUM ELECTROPLATED COATINGS

0.5.1 Wherever a reference to any Indian Standard mentioned under **0.5** or otherwise appears in this specification, it shall be taken as a reference to the latest version of the standard.

0.6 Metric system has been adopted in India and all quantities and dimensions in this standard have been given in this system. Non-metric values to which Industry has been accustomed are also given in brackets, wherever necessary, for the sake of smooth changeover by December 1966.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with *IS : 2-1949 Rules for Rounding Off Numerical Values. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

0.8 This standard is intended chiefly to cover the technical provisions relating to the construction and testing of commercial refrigerators, and it does not include all the necessary provisions of a contract.

1. SCOPE

1.1 This standard prescribes the general construction requirements of refrigerating cabinets within the range of 350 to 3 000 litres (or 12 to 106 ft^3) net internal volume, and operated by an electrically-driven refrigerating machine of the vapour compression type. The methods of carrying out tests on refrigerators are also specified. The limits of internal and ambient temperatures covered by this standard are:

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*Since revised.

Internal cabinet temperature	−20°C to +5°C (or −5°F to +40°F)
Ambient temperature	+43°C (or +110°F)

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Condensing Unit — A combination of equipment consisting mainly of compressors, condensers and liquid receivers (when required) for converting low pressure gas to high pressure liquid.

2.2 Evaporator — The part of the refrigerating system where liquid refrigerant is evaporated to produce cooling.

2.3 Freezing Compartment — The part of the refrigerator arranged and fitted for the freezing of water, ice-cream mix or other foods.

2.4 High Pressure Side — The part of the system subject to condenser pressure.

2.5 Low Pressure Side — The part of the system subject to evaporator pressure.

2.6 Refrigerant — A chemical agent used to produce cooling by expansion from high pressure liquid to low pressure gas in a refrigerating system.

2.7 Refrigerating Cabinet or Refrigerator — A complete unit comprising: (a) the refrigerating system; (b) the insulated storage compartment or compartments; and (c) auxiliaries, such as lights, fans, fittings, etc.

2.8 Storage Compartment — The part of the refrigerator meant for general cold storage.

2.9 Refrigerating System — An equipment consisting of condensing unit and evaporating unit in which refrigerant is circulated to extract and transfer heat.

2.10 Terminal Insulation — A material of low thermal conductivity employed for the purpose of retarding heat flow.

2.11 Vapour Compression Cycle — A refrigeration cycle in which a volatile liquid absorbs heat, evaporates and is compressed to a higher pressure and temperature to return to its liquid state again, by surrendering heat at a higher temperature and pressure.

3. CABINET

3.1 Inside Dimensions

3.1.1 *Inside Depth* — The inside depth shall be the mean horizontal distance between the inside surfaces of the front and the back inner walls of the liner.

3.1.2 *Inside Width* — The inside width shall be the mean horizontal distance between the inside surfaces of the side inner walls of the liner.

3.1.3 *Inside Height* — The inside height shall be the mean vertical distance between the inside surfaces of the floor and the ceiling of the liner.

3.1.4 *Internal Doors* — If internal doors are fitted in addition to the main access door, then the inner surface of the door shall be taken as the inside surface of the inner door.

3.2 Dimensions of the Evaporator Space — The depth, width and height of the evaporator space snall be the mean horizontal and vertical dimensions of the evaporator including baffles, if any. If there is an un-usable gap of 10 cm (or 4 in) or less, the dimensions concerned shall be increased by the width of the gap. The evaporator height shall include the drip tray.

3.3 Computation of Volume

3.3.1 *Gross Volume* — The gross volume shall be the product of the inside depth, inside width and inside height as defined in **3.1**.

Note — Where the cabinet is divided into more than one compartment by fixed partitions or shelves, each compartment shall be regarded as a separate unit for the purpose of computing volume.

3.4 Volume of the Evaporator Space — The volume of the evaporator space shall be the product of the width, depth and height as defined in **3.2**.

3.5 Volume of Fixed Shelves and Partitions — The volume of the fixed shelf or partition shall be the product of its area and its mean thickness.

3.6 Computation of Shelf Area — The net shelf area shall be the sum of the areas of all the shelves. In computing the area of a shelf, the width and the depth of the shelf will be the horizontal distances between the surfaces of the liner adjacent to the shelf or between the surfaces of the liner and the extremities of the shelf. Where any shelf is cut away, the area of the gap shall be deducted.

3.6.1 The net area shall be stated in cm^2.

3.7 Net Volume — The net volume shall be the sum of the gross volumes of the individual compartments less the volume of the evaporator space and the volume of the fixed shelves and partitions.

3.7.1 *Units of Measurement* — All volumes shall be stated in litres (or in ft^3 to the nearest 0·1 ft^3).

4. CONSTRUCTION

4.1 General — The refrigerator and its parts shall be constructed with the strength and rigidity adequate to normal conditions of handling, transport and usage. There shall be no sharp edges or corners liable to cause injury under normal conditions of use. Also, under normal usage, all moving parts which constitute an accident hazard shall be effectively guarded. The refrigerator shall be constructed to have an assembly design that permits removal of any defective part and its easy replacement.

4.2 Materials — Materials used in the construction of the cabinet shall comply with Indian Standards wherever applicable, except when such requirements are modified by this standard. They shall be free from defects which are liable to cause undue deterioration or failure. Under normal conditions of use, the materials used shall not shrink, warp or cause mould or odours, and shall be resistant to attack by local vermins and destructive pests; where liable to be exposed to moisture, chemically active substances, food or food products, they shall be suitably resistant and shall not contaminate stored products placed in contact with them. Sealing materials used shall not lose in service any of their essential properties, such as adhesion, plasticity and moisture resistance due to ageing, temperature and humidity variations.

4.3 Internal and External Finishes — Internal and external finishes shall be durable and capable of being cleaned effectively and hygienically without undue deterioration. All metal parts used inside the refrigerator or on the outside where they are exposed to the moisture or the ambient conditions shall be corrosion-resistant or adequately protected against corrosion.

4.3.1 Electroplated metal parts used in the cabinet shall satisfy the requirements specified in IS : 1068-1958. Cadmium plating shall not be used on any part of the storage space or its fittings.

4.3.2 Where vitreous enamelled parts are fitted, ample means shall be provided to prevent chaffing or mechanical stress likely to cause chipping. Where liable to contact with food products or other chemically active substances, the enamel shall be suitably resistant.

4.4 Thermal Insulation — The quality, thickness and application of the insulating material shall be such that efficient insulation of the cabinet is reasonably maintained. There shall be proper seals against moisture penetration by diffusion or condensation. Detachable plates and covers shall be provided with suitable seals to prevent ingress of moisture into the insulation. Highly conducting external or internal surfaces shall be separated by insulating breaker strips or their equivalent. As far as possible, no member of the frame shall penetrate the full thickness of the insulation. External surface of the cabinet shall be free from condensation under normal conditions of service.

NOTE — Reference may be made to IS : 661-1955* for recommended thicknesses of insulation.

4.5 Fittings — Linings and facings shall have sufficient mechanical strength to resist distortion and give reasonable protection to the insulation. When the doors of the refrigerated space are closed, there shall be no leakage of ambient air, either past the door gasket or by any other means.

4.6 Hardware — Door fasteners and hinges shall be smooth and positive in action and designed to maintain their proper function without undue wear under normal conditions of service. Screws and all hardware shall be of brass or other corrosion resisting material electroplated with any suitable metal.

4.7 Water Condensation — Suitable means shall be provided to prevent moisture dripping or splashing from baffles, drip trays or other cold parts on the articles placed on the shelves.

4.8 Defrosting — Means shall be provided for collecting all the defrost water from the evaporator either by a removable tray or by a fixed receptacle. Suitable arrangement shall be made for the elimination of defrost water and, where necessary, suitable means shall be provided for heating the tray for preventing freezing of defrost water.

4.9 Drains — Where drains are fitted they shall have ample capacity to cope with the requirements of normal service and shall be suitably sealed against ingress of air. They shall also be accessible for cleaning and shall not allow water to collect.

4.10 Interior Fittings — Rails and shelves shall be sufficiently strong for the duty required. Unless specified otherwise, the maximum height of any shelf shall be 1·5 m (or 5 ft) from the floor level and the depth of a shelf shall be not more than 0·75 m (or 2 ft 6 in).

4.11 Shelves — These shall be of rigid welded metallic construction, galvanized or chromium plated.

4.11.1 *Shelf-Supports* — These shall be fixed to rigid members of the structure and shall be strong enough to take the load. Special precautions shall be taken to avoid sweating of the rigid members where they are exposed.

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*Since revised.

4.12 Inner lining shall be of suitable metallic sheets or other equivalent material and shall be non-corrosive. All joints shall be water-tight.

4.13 Multiple Compartments — Where special compartments are provided for the storage of produce or goods likely to contaminate other items of storage, they shall be adequately sealed from the remainder of the cabinet.

4.13.1 *High Humidity Compartments* — Where a food storage compartment maintained at high humidity is provided in the cabinet, provision shall also be made to retard mould and bacteria growth by using devices, such as ultra-violet lamps of sufficient output and very little heat output and/or activated charcoal odour absorbers.

5. REFRIGERATING SYSTEM

5.1 Construction — Pipes and connections to moving or resiliently mounted parts shall be so arranged as not to foul, or transmit vibrations to other parts. Pipes and connections shall be securely fixed and sufficient free length shall be provided to minimize the risk of failure due to fatigue. Where necessary for normal operating conditions, pipes and valves shall be thermally insulated. The refrigerating system shall be free from undue noise or vibration.

5.1.1 The evaporator may be of copper, brass or aluminium. Copper evaporator shall be hot dip-tinned, electro-tinned or oxidized. Stainless steel may also be used for this purpose.

5.2 Water Condensation — Suitable means shall be provided to prevent water condensed on cold parts or pipes of the refrigerating system from affecting the operation of the unit of its controls.

5.3 Safety Features in Design — The refrigerating system shall be assembled in accordance with good engineering practice and shall meet the requirements laid down in IS : 660-1955* as also of reliability, durability and adequacy of the unit to preserve the stores. The refrigerating system shall be so designed that it will suffer no damage if the door of the cabinet is left open accidently in ambient air of the temperature specified in the conditions of contract or if the unit starts with a high pressure on the low side. When the door is left open under normal operating conditions, the automatic motor overload protective device may come into operation.

5.4 Control of Operation — Refrigerant flow and compressor driving motor operation shall be automatically controlled to reduce the cabinet temperature to the temperature specified and to maintain it within the limits of application. Strainer and dehydrators shall always be provided in the liquid line.

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*Since revised.

5.5 Location of the Components — The evaporator, screens, baffles, drip tray, etc, shall not obstruct access to the stored products. All control devices and service valves shall be readily accessible. Where the evaporator incorporates facilities for making ice, ice-trays shall be capable of being removed without disturbing the stored products.

5.5.1 *Fixing of the Evaporator* — It shall be fixed on suitably insulated supports.

6. ELECTRICAL EQUIPMENT

6.1 Ratings of Motors — All motors shall be of types suitable for their particular applications. Motors shall conform to the requirements of IS : 325-1959* or IS : 996-1959* whichever is applicable.

6.2 Motors shall be adequtely protected against dangerous over-heating arising from excessive flow of current.

6.3 Motor Starters, Relays, Thermostat, Controls, etc — All switching devices in the main motor circuit shall be capable of breaking the stalled current of the motor. Switching devices shall be so designed or located that they are not affected by moisture during the normal use. They shall be suitable for operation at the applied voltage. Suitable types of radio interference suppressors shall be fitted, where required.

6.4 Wiring — Electrical wiring and connections shall conform to the requirements of IS : 732-1958*, and also the Indian Electricity Act, 1910 and Indian Electricity Rules, 1956. All electrical joints shall be electrically and mechanically secure. Where any wire or cord passes through metal holes, the metal edges shall be fitted with rubber piece, as shown in Fig. 1, so as to protect the cord from damage.

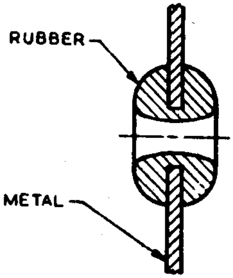

FIG. 1 RUBBER PROTECTION FOR CORD

6.4.1 Live parts shall be protected by suitable guards, shields, or screen of adequate strength and durability to avoid the possibility of making inadvertent contact therewith during normal service conditions.

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*Since revised.

6.4.2 The entry to the cabinet for refrigerant pipes, electrical wires and thermo-static capillary tubing shall be taken through conduit and properly sealed against moisture ingress.

6.5 Electrical Accessories — All internal electrical fittings, such as lamps, switches, fans, etc, shall be provided with guards for protection against mechanical damage and shall be suitable for operation at the lowest air temperature likely to occur.

6.6 Earth Connection — The metal sheathing of the cables and the metal casings of the electrical components shall be assembled and bonded to ensure earth continuity and connected to a suitable earth terminal. The metal frame or chassis of the refrigerator cabinet shall also be suitably earthed.

7. TESTS

7.1 Type Tests — The following shall constitute the type tests:

a) Pressure tests,
b) Component tests,
c) Insulation resistance test (Assembly test),
d) Thermal insulation test,
e) Condensation test,
f) Rating tests,
g) Test for adequate rating of compressor motor, and
h) Door seal test.

7.1.1 Once a refrigerator has undergone type tests, any major alteration which the manufacturer intends to make in the refrigerator shall be reported to the appropriate testing authority recommended by the Indian Standards Institution, and further type tests shall be carried out on the modified refrigerator in accordance with the procedure (*see* **7.5**) laid down in this standard.

NOTE — The testing facilities are at present available with the National Physical Laboratory, Hill Side Road, New Delhi, and the *Government Test House, Alipore, Calcutta.

7.2 Production Routine Tests — Every commercial refrigerator after completion shall be subjected to the following routine tests at the manufacturer's works which shall be carried out without loading the refrigerator:

a) Thermostat test,
b) Electric insulation test,
c) Door seal test, and
d) Test for adequate rating of compressor motor.

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*Now known as National Test House.

7.2.1 The manufacturer shall furnish with each commercial refrigerator a certificate that the production routine tests prescribed in **7.2** have been conducted in accordance with the procedure given in **7.6** and that the unit conforms to the requirements of the standard.

7.3 Acceptance Tests — If the purchaser desires any of the production routine tests specified in **7.2** to be repeated, then where agreed to between the purchaser and the manufacturer, the tests may be conducted at the manufacturer's works.

7.4 Samples for Tests

7.4.1 *Type Tests* — Two refrigerators of each size shall be sent along with manufacturers detailed specification to the appropriate testing authority for purposes of type tests.

7.4.2 *Acceptance Tests* — The number of samples shall be as agreed to between the customer and the manufacturer.

7.5 Test Procedures for Type Tests

7.5.1 *Pressure Tests* — The minimum test pressure in kg per cm^2 shall be as given below:

a) *High pressure side* — The saturation vapour pressure of the refrigerant at 75°C (or 167°F).

b) *Low pressure side* — The saturation vapour pressure of the refrigerant at 50°C (or 122°F).

7.5.1.1 In no case shall the test pressure be less than 3·5 kg/cm^2 (or 50 lb/in^2) gauge. No part of the assembly under test shall show signs of leakage or permanent distortion after being subjected to the above tests for a period of not less than ten minutes.

7.5.2 *Component Tests* — Before assembly, the individual electrical components shall be subjected to insulation resistance and high-voltage tests in accordance with the test methods laid down in the appropriate Indian Standards wherever they exist.

7.5.3 *Insulation Resistance Test (Assembly Test)* — The insulation resistance between all the electrical circuits and earthed metal parts when measured at normal room temperature with a DC voltage of 500 volts or more shall be not less than one megohm.

7.5.3.1 Normal electrical insulation shall withstand a high-voltage test of 1 000 volts RMS applied for not less than 5 seconds between all circuits and accessible metal parts. The test voltage shall be alternating and of any convenient frequency between 25 and 100 cycles per second.

7.5.4 *Thermal Insulation Test* — The insulated structure of the cabinet after assembly shall be tested by the heat input method to determine its thermal transmittance. For this purpose, the interior of the cabinet shall be heated by an electrical heater or heaters suitably shielded to prevent radiation to the walls and so located as to ensure a uniform temperature of 15 ± 1·5°C above the average ambient temperature of the test room and maintained at that temperature for 30 hours; and records required for the test taken hourly during the last six hours. The thermal transmittance shall not exceed the specified value.

NOTE — Suitable value for thermal transmittance is under study and will be specified at a later date.

7.5.5 *Condensation Test* — The refrigerator shall be held at normal internal temperature of operation in the maximum ambient temperature for which it is designed with air at a relative humidity of 80 percent. Condensation on the exterior surfaces shall not occur during an exposure of not less than 24 hours after conditions have been steady.

7.5.6 *Rating Tests*

7.5.6.1 The cabinet and the refrigerating mechanism shall be assembled and set up as they would be installed in service. All the accessories shall be in their proper places but the cabinet shall otherwise be empty. Ice trays where fitted shall be empty. A run-in period of 24 hours shall be given to the refrigerator to ensure thorough working of the mechanical parts before the refrigerator is put on test.

7.5.6.2 Before the start of any test, the refrigerator shall be allowed to operate at test conditions for a sufficient length of time to establish equilibrium. The period of stabilization shall be at least 12 hours, and when the cabinet temperature has been changed (but the ambient temperature held constant) this period of stabilization shall be at least 8 hours. Equilibrium shall be considered to be established when the average cabinet-air temperature does not vary more than 0·3°C (or 0·5°F) in the last 3 hours of the stabilizing period.

7.5.6.3 The refrigerator shall be run for a period of at least 24 hours after steady conditions are attained (*see* **7.5.6.2**) with the average cabinet-air temperature specified in Table 1. Measurement and record shall then be made of the following:

a) Ambient temperature,

b) Average cabinet-air temperature,

c) Consumption in kWh per 24 hours, and

d) Percentage running time for 24 hours.

NOTE — This is a 'no-load' test and does not take into account the effects of produce cooling, ice making, door opening or other loads which may be encountered in normal service.

TABLE I TEST TEMPERATURES

(*Clause* 7.5.6.3)

Ambient temperature	As specified in contract (*see* 1.1)
Average cabinet-air temperature or internal cabinet temperature	do
Motor winding temperature, *Max*:	
a) Hermetically sealed compressor unit	Shall be suitable for working in the conditions of the sealed unit for which they are applied.
b) Open type condensing unit	Shall not exceed limits of temperature-rise mentioned in IS : 325-1959* or IS : 996-1959* whichever is applicable.
Motor winding temperature-rise above ambient, *Max*:	
a) Hermetically sealed compressor unit	Shall be suitable for working in the sealed unit for which they are applied.
b) Open type condensing unit	Shall not exceed limits of temperature-rise mentioned in IS : 325-1959* or IS : 996-1959* whichever is applicable.

NOTE — Where refrigerator provides two or more storage compartments at different temperatures, the appropriate cabinet-air temperature in each compartment shall be held simultaneously.

*Since revised.

7.5.7 *Test for Adequate Rating of Compressor Motor*

7.5.7.1 When exposed to the specified ambient temperature, the refrigerator shall pull down from equalized pressure conditions in the system to the specified cabinet temperature, and maintain that temperature with the machine running continuously. Controlled heat shall be applied inside the cabinet to ensure that the motor runs continuously.

7.5.7.2 To ensure an even cabinet temperature, a fan shall be used to circulate the air. Under these conditions, the motor winding temperature shall not exceed the values specified in Table I.

7.5.7.3 If any test is interrupted by any self-acting device protecting the motor from over-current, the device shall be allowed to restore the circuit as soon as its normal operation permits.

7.5.8 *Door Seal Test* — The door seal shall be tested to ensure that the gasket will grip on a strip of paper 0·08 mm (or 0·003 in) thick and 50 mm (or 2 in) wide when the door is normally closed on it.

7.6 Test Produce for Production Routine Tests

7.6.1 *Thermostat Test* — The thermostat shall be placed on the next colder position after defrost and the unit started. The refrigerator shall be allowed to run till it stops automatically due to cutting out of the thermostat. The time for one cycle shall be noted. After an interval of 5 minutes, the thermostat shall be turned to the coldest and to the warmest positions to find if the refrigerator starts and stops due to the action of the thermostat.

7.6.2 *Electric Insulation Test* — Electric insulation test shall be carried out as stated in 7.5.3 and 7.5.3.1.

7.6.3 *Door Seal Test* — Door seals shall be tested for tightness as described in 7.5.8.

7.6.4 *Test for Adequate Rating of Compressor Motor* — Adequate rating of compressor motor shall be tested as described in 7.5.7.

7.7 General Requirements for Tests

7.7.1 *Test Conditions*

7.7.1.1 The refrigerator shall be so placed or shielded as to prevent direct radiation from the heating equipment or other sources of heat. Air circulation in the test room shall be such that the specified uniformity of temperature distribution is obtained without a direct draught upon the refrigerator under test. The refrigerator shall be shielded from extraneous air currents, which exceed 15 m/min (or 50 ft/min). The machine shall be placed on a wooden platform with solid top. The cabinet shall be placed centrally in the room.

7.7.1.2 The interior of the cabinet shall be dried immediately before the steady state condition preceding the tests.

7.7.1.3 The cabinet door or doors shall be kept closed during each test.

7.7.2 *Temperatures*

7.7.2.1 *Ambient temperatures*

a) Ambient temperature shall be maintained to within ± 1°C (or ± 2°F) of the specified value, and shall be measured at points located at 1 m (or 3 ft) from the floor and 0·25 m (or 10 in) from the sides and front of the cabinet. This condition shall be maintained during both stabilizing and test periods.

b) The ambient temperature shall be recorded at one of the above positions, preferably with a recording instrument. If an indicating instrument is used, readings shall be taken at intervals of 30 minutes.

c) The vertical temperature gradient from the floor to a height of 2 m (or 7 ft) shall not exceed 1·5°C for each metre (or 1°F for each foot) or vertical distance.

7.7.2.2 *Internal cabinet temperature*

a) Cabinet-air temperatures shall be measured in at least six representative positions, and the mean shall be taken as the cabinet temperature.

b) In cabinets where compartments are provided, the temperature of each compartment shall be recorded in a number of representative positions, as given below:

Size of Compartment	*No. of Positions*
100 litres (or 3 ft^3) or less	1
100 litres to 350 litres (or 3 ft^3 to 12 ft^3)	3
350 litres (or 12 ft^3) and above	6

c) The cabinet-air temperature shall be taken with a recording instrument placed approximately at the point of average temperature, and the temperature drift through the test period shall not exceed 0·3°C (or 0·5°F).

d) All temperature measuring elements shall be supported in the refrigerator in such a manner that there will be at least 15 mm (or $\frac{5}{8}$ in) of air space separating the thermal element from contact with heat conducting surfaces in the refrigerator. Connections from the temperature measuring elements shall be brought to the outside of the cabinet in such a manner as to interfere as little as possible with air seals.

7.7.3 *Electric Power Supply*

7.7.3.1 In all tests, the supply voltage shall be within ± 2 percent of:

a) the voltage marked on the nameplate, or

b) the mean if the maximum and the minimum range is marked on the nameplate.

7.7.3.2 The supply frequency in the case of AC shall be within ± 1 percent of the frequency marked on the nameplate.

7.7.4 *Instruments and Measurements*

7.7.4.1 The instruments used for measuring shall be calibrated against a secondary standard before making each test or series of tests.

7.7.4.2 Temperature measurements shall be made with one or more of the following instruments, measurements being accurate to 0·3°C (or 0·5°F):

a) Mercury-in-glass thermometers,
b) Thermocouples, and
c) Electric resistance thermometers.

7.7.4.3 Pressure measurements, when taken, shall be made with Bourdon tube gauge, the accuracies of measurement for suction pressure (absolute) and other pressure (absolute) being ± 75 g/cm^2 (or ± 1 lb/in^2) and ± 150 g/cm^2 (or ± 2 lb/in^2) respectively.

7.7.4.4 Watt-hour meter shall be capable of being read up to 0·01 kWh.

7.7.4.5 The operating time of the unit shall be obtained by means of a recording meter or a self-starting synchronous electric clock.

8. MANUFACTURER'S CERTIFICATE

8.1 The manufacturer shall furnish with each refrigerator a copy of the type test certificate and shall also certify that the refrigerator has been manufactured according to the type tested by the appropriate testing authority and that it conforms to the requirements of this standard.

8.1.1 The manufacturer's certificate shall be not necessary, unless specifically demanded by the consumer, if the refrigerator bears the ISI Certification Mark (*see* **9.3**).

9. MARKING

9.1 Each refrigerating cabinet shall have the following information marked on a nameplate in a permanent and legible manner in a location where it is accessible and easily visible after installation:

a) The name and address of the manufacturer or sponsor of the completely assembled refrigerating cabinet;

b) Type, model catalogue and serial number of the cabinet, compressor, motor, etc, or sufficient information to provide adequate identification for replacement of parts or necessary servicing;

c) Normal running current, voltage of the supply circuit, and in the case of AC, the frequency for which the refrigerator is designed; and

d) The name and the maximum weight of the refrigerant used and of any warning agent that has been added.

9.2 Information to be Supplied by the Manufacturer — The manufacturer or the supplier shall also provide information regarding: (a) operating instructions; (b) gross storage volume; and (c) the net storage volume, and net shelf area as specified in **3**.

9.3 Each unit may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

INDIAN STANDARDS INSTITUTION

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002
Telephones : 331 0131
331 1375

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices:

		Telephone
*Western	: Manakalaya, E9 MIDC, Marol Andheri (East) BOMBAY 400093	6 32 92 95
†Eastern	: 1/14 C. I. T. Scheme VII M V.I.P. Road, Maniktola CALCUTTA 700054	36 24 99
Northern	: SCO 445-446, Sector 35-C CHANDIGARH 160036	2 18 43 3 16 41
Southern	: C. I. T. Campus MADRAS 600113	41 24 42 41 25 19 41 29 16

Branch Offices:

'Pushpak', Nurmohamed Shaikh Marg, Khanpur AHMADABAD 380001	2 63 48 2 63 49
F' Block, Unity Bldg, Narasimharaja Square BANGALORE 560002	22 48 05
Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar BHOPAL 462003	6 67 16
Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002	5 36 27
53/5 Ward No. 29, R. G. Barua Road, 5th Byelane GUWAHATI 781003	—
5-8-56C L. N. Gupta Marg, HYDERABAD 500001	22 10 83
R14 Yudhister Marg, C Scheme, JAIPUR 302005	6 34 71 6 98 32
117/418 B Sarvodaya Nagar, KANPUR 208005	21 68 76 21 82 92
Patliputra Industrial Estate, PATNA 800013	6 23 05
Hantex Bldg (2nd Floor), Rly Station Road, TRIVANDRUM 695001	52 27

Inspection Office (With Sale Point):

Institution of Engineers (India) Building, 1332 Shivaji Nagar PUNE 411005	5 24 35

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*Sales Office in Bombay is at Novelty Chambers, Grant Road, BOMBAY 400007	89 65 28
†Sales Office in Calcutta is at 5 Chowringhee Approach, P.O. Princep Street, CALCUTTA 700072	27 68 00

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